Asbestos-Contaminated Soil Risk Overview

Colorado Department of Public Health And Environment
Hazardous Materials and Waste Management Division

Components of Risk

- Risk exists with the presence of a contaminant and an exposure pathway to a receptor
- Risk = hazard + exposure pathway + receptor
  - No risk is present with the absence of any of the above
  - May not eliminate the potential for future risk if a hazard is present

Evidence Supporting the Current Asbestos In Soil Regulation

- **Several studies using a variety of approaches, including the state of the science, for the release of asbestos fibers from significantly <1% asbestos in soil/debris demonstrated:**
  - **All types of asbestos fibers can be released into the air or breathing zone during soil disturbing activities resulting in unacceptable risk**:
    - Significantly above acceptable cancer risk level of 1 in a million at 0.000004 f/cc (EPA IRIS)
    - Even above the OSHA limit of 0.1 f/cc, in some cases

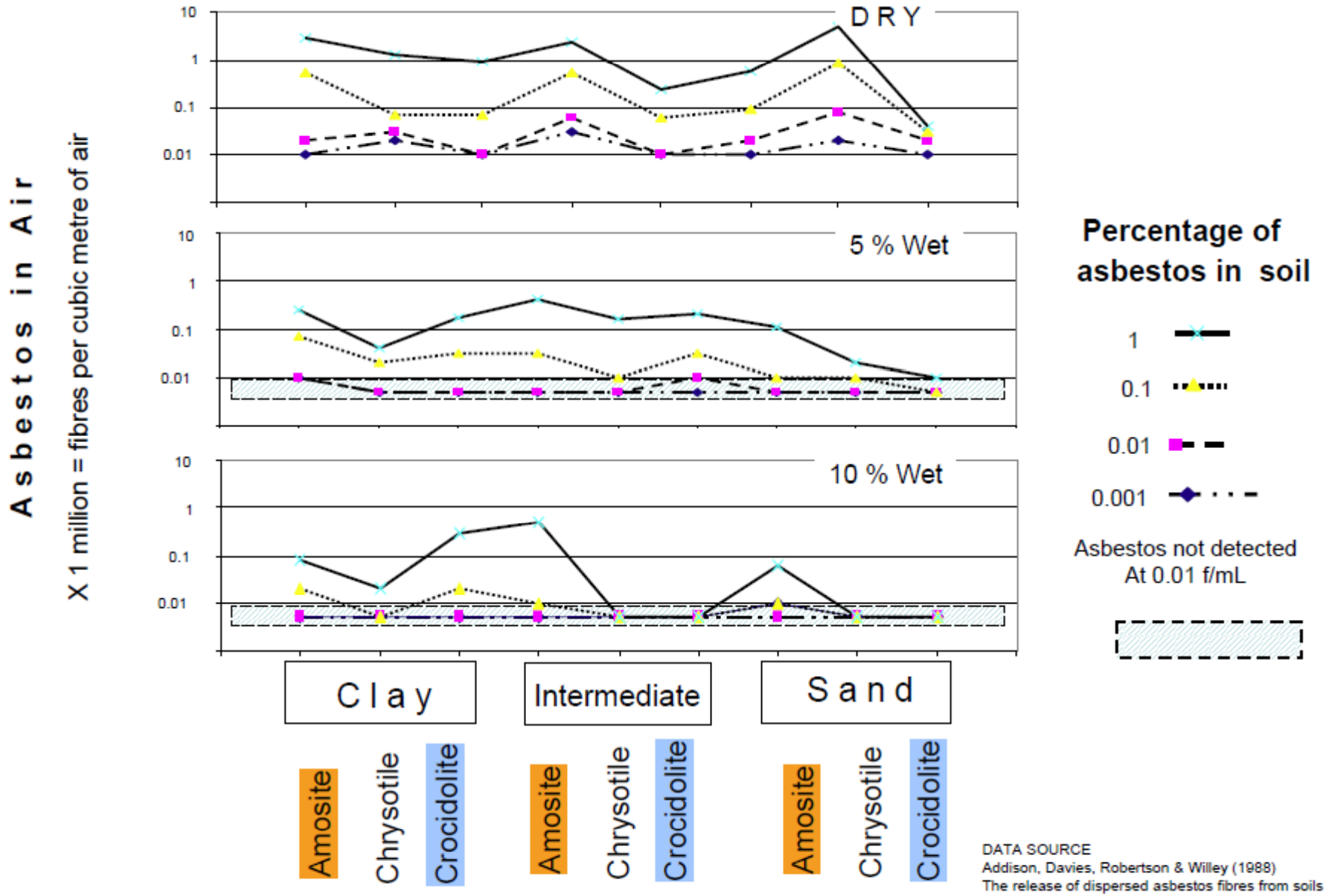
Irrespective of fiber type or soil type, as low as 0.001 % asbestos in soil can generate airborne respirable asbestos concentration of >0.01 f/cc (Addison et al., 1988)

Evidence:Experimental Enclosures (Glove Box Studies)

- **Addison et al. (1988):**
  - Chrysotile 0.001% in intermediate soil = 0.08 f/mL
  - Chrysotile 0.1 % in clay soil = 0.42 f/mL
  - Crocidolite 0.1 % in clay = 1.12 f/ml
- **Januch and McDermott (EPA, 2004):**
  - Mixture of <1% Libby amphibole plus amosite and chrysotile = up to 6.5 f/cc

0.000004 f/cc=EPA's risk-based asbestos target concentration in air at lifetime excess cancer risk of 1 in a million

Asbestos in air related to soil amount, mineralogy, soil type and soil moisture



DATA SOURCE
Addison, Davies, Robertson & Willey (1988)
The release of dispersed asbestos fibres from soils
Report # TM/88/14 September 1988 Edinburgh
Institute of Occupational Medicine

MVA 2008

Action Levels for Asbestos in Soil/Debris

B. EPA issued an OSWER directive (EPA, 2004):

- Significantly <1% asbestos in soil/debris can release unacceptable air concentrations of all types of asbestos fibers
- Recommends developing site-specific risk-based action level to determine if response action is needed

EPA (2004) OSWER directive provides support to the CDPHE asbestos in soil regulation

Exposure: Modified Elutriator Method

Berman and Kolk (2000)

- **Initial Health Risk Assessment at the Former Lowry Air Force Base, Colorado (Parsons, 2004):**
  - **<1% chrysotile in surface soil resulted in excess potential cancer risks, for example:**
  - – Running and walking by residents = 1 or 4 in 100,000
  - – Construction worker = 2 in 10,000

Overall potential risks are underestimated due to major limitations of dust models used to predict airborne asbestos exposures

Exposure: Activity-Based Personal Monitoring

- **Libby studies (EPA, 2001 Weis Memo):**
  - **Roto-tilling of garden soil (<1% asbestos)**
    - 0.066 f/cc in personal monitor (Cancer risk = 1 in 100,000)
    - 0.019 f/cc in stationary monitor
  - **Soil bagging and sweeping floors (<1% to 6% asbestos)**
    - >5.0 f/cc (above OSHA limit of 0.1 f/cc)
- **Oregon studies (EPA, 2004 Januch and McDermott):**
  - **Leaf blowing (soil <1% asbestos)**
    - 0.045 f/cc for equipment operator
    - 0.033 f/cc for observer

Components of a Risk Assessment

- Establishing exposure assumptions
  - Who (workers, workers families, trespassers, residential receptors, etc.)
    - Primary/direct and secondary/indirect exposures
  - Exposure Duration
  - Exposure Frequency
  - Exposure Time
- All of these components have the considered when constructing a risk assessment scenario

Evidence:CDPHE (2003) Screening-Level Risk Evaluation

- **To evaluate whether unacceptable risks could occur as a result of some outdoor activities at the Former Lowry Air Force Base, Colorado:**
  - **Adopted asbestos air concentration = 0.019; 0.06; or 0.066 f/cc**
    - Libby garden study; < 1% in soil
    - Addison et. al.,1988 study; 0.1% in soil
      - **Child risk = 1.4 in 100,000**
        - » Swinging 1hr/d, 80 d/y
        - » Playing with soil 1hr/d, 15d/y
      - **Adult risk = 2.6 in 100,000**
        - » Roto-tilling 2 hr/d, 8 d/y
        - » Gardening 2 hr/d, 20d/y
        - » Bagging excavated soil 1 hr/d, 8 d/y

CDPHE (2003) Screening-Level Risk Evaluation (Cont.)

- **Why results of CDPHE's asbestos risk evaluation were not used to derive acceptable levels of asbestos in soil**
  - Semi-quantitative in nature
  - SIGNIFICANT RISKS from outdoor and indoor exposure pathways NOT evaluated
    - Addressed **only some outdoor** activities
    - Outdoor-to-Indoor exposure pathway NOT addressed
  - Complex relationship between soil and air levels of asbestos.
    - The most critical determining factor is the degree of mechanical disruption
    - Asbestos in soil level corresponding to EPA IRIS Acceptable level in air = 0.000004 f/cc is NOT KNOWN at this time

Assessment Of Health Risks For Asbestos-Contaminated Soil/Debris

A. Potential Exposure Pathways:

- **Outdoor activities routinely performed by residents (child and adult), for example:**
  - Gardening; roto-tilling; weeding; bagging and sweeping of excavated soils; children playing with soil/debris;
- **Transport from outdoor to indoor:**
  - Wind through open doors and windows
  - Track-in of adhered fibers on clothing and shoes of children and adults, and through pet animals
  - Children physically carrying asbestos-contaminated soil/debris

Outdoor and indoor asbestos sources act as a reservoir of fibers that could continue to be released to the air as a result of routine activities

Current Issues In Risk Assessment of Asbestos-Contaminated Soil/Debris

Examples of Major Issues/Limitations:

- Potential future indoor exposures as a result of outdoor-to-indoor transport are difficult to quantify
- Exposure assessment provides a snap-shot in time
- Cancer and non-cancer toxicity continues to be re-evaluated
- Better definition of asbestos fibers related to its toxic potential is needed (e.g. chrysotile vs. amphibole, size of fibers)

Methods for estimating asbestos exposure dose allow qualitative/semi-quantitative screening risk assessment

Summary of Asbestos Exposure and Risk Issues

- Asbestos is a generic term used to describe the fibrous varieties of six minerals which fall into two categories: serpentine and amphibole.
- Asbestos fibers are known to be persistent in the environment.
- All types of asbestos are a known human carcinogen and can cause nonmalignant lung and pleural diseases.
- The 1% threshold for asbestos in soil/debris may not be protective of human health and should not be used as the default action level (EPA, 2004).
- Soil/debris containing significantly <1% of all types of asbestos can pose unreasonable risk to human health (EPA, 2004).
- Asbestos fibers in soil/debris do not inherently pose a risk to human health if left undisturbed.

Summary of Asbestos Exposure and Risk Issues (cont.)

- **Health risks from asbestos-contaminated soil/debris will depend on the potential for asbestos to become airborne and be inhaled.**
  - EPA IRIS cancer risk-based acceptable ("safe") level of asbestos in air = 0.000004 f/cc at a risk level of 1 in a million.
  - The concentration of asbestos in soil corresponding 0.000004 f/cc in air is not known at this time.
- **Asbestos health risk assessment is an evolving science; EPA has developed a risk assessment framework.**
- **Current risk assessment methods can be used to:**
  - Demonstrate complete exposure pathway(s); and
  - Estimate risk qualitatively/semi-quantitatively

Target Risk Values

CDPHE target risk is typically $1x10^{-6}$

EPA target risk is $1x10^{-4}$ – $1x10^{-6}$

EPA IRIS $1x10^{-6}$ value = 0.000004 f/cc

Real World Questions

- Evaluation of sample collection method?
- Evaluation of sample preparation methodology?
- Evaluation of sample analysis methodology?
- Extrapolation of concentration of asbestos in soil to an airborne asbestos concentration?

Real World Calculations

- If using the EPA IRIS $1x10^{-6}$ value of 0.000004 f/cc
- Assuming total release of fibers from soil this equates to 3.05 f/cubic yard
- Assuming a grid size of 50'x50'x0.5' this equates to 141.2 f/grid
- How do we adequately characterize a grid to determine asbestos concentration?????
  - Discrete vs. Composite?
  - Sample density?
  - Surface vs. sub-surface characterization?
  - Sample distribution?
  - Analytical sensitivity?